

SPALLATION NEUTRON SOURCE QUALITY PROCEDURE

Inspection / Testing of Pressure Vessels and Pressure Relief Devices

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Approval

FL Korne SNS Operations Manager 13 March, 2006 Date

Quality System Procedure

Title: Inspection / Testing of Pressure Vessels and Pressure Relief Devices

1 Purpose:

The purpose of this procedure is to establish a program of periodic inspection and testing of pressure vessels and pressure relief devices supporting SNS facility operations. This program meets the requirements of the National Board Inspection Code (ANSI/NB-23) and ORNL SBMS Subject Area, Pressure Vessels and Related Components. This procedure also addresses the requirements for periodic recertification of relief devices as called out in the Accelerator Safety Envelope (ASE) for Credited Engineered Controls (CEC).

Pressure vessels, relief valves and rupture disks are critical components of pressurized systems and must function properly in order to ensure system and personnel safety in the event of an inadvertent over pressurization.

2 Scope

The scope of this procedure includes the inspection, testing, and preventative and predictive maintenance of SNS facility pressure vessels and pressure relief devices. Equipment addressed by this procedure include air receivers, heat exchangers, expansion tanks, delay tanks, and storage tanks fabricated to the requirements of the ASME Boiler and Pressure Vessel Code, stamped, and registered with the National Board. Relief valves, safety valves and rupture disks with the previously listed equipment are included in program.

3 Prerequisites

This procedure requires either direct or remote access to the pressure vessels and relief devices. If the relief device is scheduled to be removed for recertification testing, the associated system must be depressurized and in such a condition that the device can be physically removed. The system will be out of service until the relief device is reinstalled and any post installation testing performed to declare the system fit for use.

4 Definitions

ASME Code. The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code establish the Rules of Safety governing the design, fabrication, and inspection during construction of Boilers and Unfired Pressure Vessels.

Authority Having Jurisdiction (AHJ). The organization or individual responsible for providing a decision on a specific technical question regarding national, state, or local codes and DOE orders.

Code of Record. The specific edition and addenda of the code under which a pressure vessel, piping system, or relief device was fabricated and certified to meet the stipulated requirement.

National Board Inspection Code (NBIC). It is the purpose of the National Board Inspection Code to maintain the integrity of pressure vessels and pressure retaining devices after they have been placed into service. The code does this by providing rules and guidelines for inspections after installation, repairs, alterations, or re-rating, thereby helping to ensure that these objects may continue to be safely used.

Nondestructive Testing (NDT). Any testing method which does not involve damaging or destroying the test sample; including the use of x-rays, ultrasonics, radiography, magnetic flux, and so on.

Owner-User (Inspection Organization). An owner or user of pressure retaining items that maintains an established inspection program, whose organization and inspection procedures meet the requirements of the National Board rules and are acceptable to the jurisdiction or jurisdictional authority wherein the owner is located.

Pressure Vessel. A container designed and built to hold pressurized fluids in accordance with the B&PV Code.

Relief Valves. An automatic pressure-relieving device actuated by the static pressure upstream of the valve that opens further with an increase in pressure over the opening pressure. Such relieving action affords suitable protection for vessels or systems where there is no need for instantaneous release of large volumes and where sufficient leeway is provided between the design pressure and the operating pressure in the system.

Rupture Disk. A non-reclosing relief device actuated by inlet static pressure and designed to function by bursting of a pressure-containing disk.

Safety Valve. An automatic pressure-relieving device actuated by the static pressure upstream of the valve characterized by full-opening pop action and are used with gases such as steam, air, or vapors.

Safety Relief Valve. An automatic pressure-relieving device suitable for use either as a safety valve or relief valve, depending on the application.

5 Responsibilities

5.1 Responsible System Engineer

5.1.1 The cognizant Responsible System Engineer shall identify all code stamped pressure vessels in their system with the associated pressure relieving devices and ensure they are placed into the preventative maintenance database. For each item identified the following information should be provided:

- Code of record
- Specific location of the item
- Type of service (liquid, gas, vapor, etc.)
- Potential hazards (radioactive contamination, toxic substance, etc.)
- Item tag or identification number, as applicable
- Required inspection intervals for periodic visual and recertification testing
- Identification of CEC required inspections and recertification

- 5.1.2 The cognizant Responsible System Engineer shall ensure that any system changes to the pressure vessels, their pressure relieving devices, or inspection intervals are reflected in the preventative maintenance database.
- 5.1.3 The Maintenance Coordinator in coordination with the Responsible System Engineer shall ensure that spare rupture disks and relief valves are available in advance of planned rupture disk or relief valve replacement.
- 5.2.3 The Maintenance Coordinator will work with the Responsible System Engineer and the Purchasing Group (as necessary) to identify support resources holding the necessary ASME and NB certifications to perform the required inspections and relief valve re-certifications when required.

6 Requirements

6.1 Pressure Vessel

- 6.1.1 The National Board of Boiler and Pressure Vessel Inspectors requires that ASME B&PV Code Stamped pressure vessels receive some form of periodic inspection to determine its condition for continued acceptable performance in service. The in-service environment can cause deterioration of the vessel over time that would render the vessel unsafe for its intended service. The inspections need to be performed by a qualified inspector.
- 6.1.2 The inspection frequency is a variable interval based on the continued condition of the vessel. The Board provides some guidelines for the initial interval then subsequent intervals are based on the found condition of the vessel. The initial interval is between two (2) years of service and ten (10) years of service depending on the vessel materials and the service conditions. Ten years is the maximum interval for all types of service.
- 6.1.3 Deterioration of the vessel is a function of the vessel materials, the fluid or gas contained in the vessel, and the service conditions of pressure and temperature to which it is exposed. Deterioration of the vessel can result from corrosion cracking or pitting, erosion, mechanical fatigue, excessive pressure or temperatures, or hydrogen embrittlement.
- 6.1.4 The inspection may be a visual inspection of the vessel interior (where possible) or NDE inspection of critical areas from the exterior of the vessel, or combination of the two as needed to determine the condition of the vessel.
- 6.1.5 The inspection will yield an estimate of remaining useful life assuming that the service conditions continue as previously. The estimate is roughly based on the minimum detected wall thickness minus the required thickness for the intended service divided by the deterioration rate from vessel inspection history. If the vessel condition is nearing end of life, a replacement should be procured or if possible to de-rate the service conditions to extend the vessel's useful life.
- 6.1.6 Many of the pressure vessels are located in locations that present hazards that may impact the feasibility of performing periodic inspections. Some may contain process fluids that are radioactive or are located in radioactive areas where ALARA concerns may

override the necessity for periodic direct inspections. In such circumstances, other methods of determining the acceptability of the tank's condition need to be developed.

6.2 Pressure Relief or Safety Relief Valves

- 6.2.1 Pressure relief valves are installed into pressurized systems to ensure that the service pressure of the system does not exceed the system design parameters.
- 6.2.2 Pressure relief or safety relief valves are manufactured by ASME qualified suppliers that have qualified designs for relief valves that have demonstrated their capabilities under test. They are adjusted for the requested service conditions through a certified calibration program and the valves are sealed with a code stamped data plate attesting to the intended service conditions of the valve.
- 6.2.3 The relief valve should be tested at periodic intervals to ensure that it still is providing the intended protection from over pressurization. The testing must include the valve opening pressure, the valve reclosing pressure and the reclosed valve seat leakage evaluation. The testing may be performed by the owner of the unit or a qualified testing facility. The testing must be performed to a reviewed and approved testing procedure.
- 6.2.4 If a relief valve is found to operate outside the allowable tolerances for the service application Code of Record, then it must be repaired and recertified by an ASME "VR" stamped facility. Alternately, the valve may be retired from service and replaced with a new certified relief valve of the correct size and operating parameters.
- 6.2.5 The inspection interval is based on the service conditions of the valves. The initial interval for valves that are used on Air and Dry Gas systems is every three (3) years. Refrigerant systems have an initial interval of every five (5) years. Fluid systems are not specifically called out in the code, but should be based on the history of use from similar systems until a specific system history is established.
- 6.2.6 Experience has shown that a more frequent visual inspection of relief valves is beneficial in ensuring the continued protection of the pressurized system. At least annually, valves should be visually inspected to the extent possible for signs of leakage, damage, or corrosion. In addition, the discharge line from the valve should be visually examined to ensure that it is free of obstructions that could inhibit the discharge of the valve if needed.
- 6.2.7 Some process systems will contain radioactive fluids that will contaminate their associated relief valves. These valves will be decontaminated to the extent practical. If they can not be decontaminated to such a level that they may be tested by a certified testing organization, then they will be replaced with new certified relief valves.

6.3 Rupture or Burst Disks

- 6.3.1 Rupture or burst disks are non-reclosing pressure relieving devices that provide over pressure relieving capabilities. By their nature, they are inherently simple. They are fabricated by an ASME certified supplier and are specifically built for each individual service application. They are batch certified for performance parameters.

- 6.3.2 Operating service conditions may over time weaken the burst disks and it may relieve at a pressure less than its certified burst pressure. This is a failure in the safe direction, however, it can be an operational nuisance. Examples of such contributing factors are operating pressures up to or in excess of 90% of burst rating, operating temperatures in excess of the certified temperature, excessively back pressures, or chemical action due to contact with the process fluids. Not influencing rupture setpoints is an excessive number of pressure cycles producing material fatigue that shortens disk life and requiring more frequent replacements.
- 6.3.3 Rupture or burst disks can not be tested as any such test destroys the disk. The only means of ensuring their continued protection at the intended pressure set point is to replace them on an appropriate periodic basis. The recommended intervals for replacement are the same as for the testing of relief valves.
- 6.3.3 Rupture or burst disks are designed to work with a holding fixture and in a very specific orientation. Their replacement must be in strict accordance with a very detailed replacement procedure in order to ensure their activation at their designated set points. Some disks are welded into the system and are not replaceable except by cutting them out and welding in replacements.
- 6.3.4 As with relief valves, experience has shown that a more frequent visual inspection of rupture disk is beneficial in ensuring the continued protection of the pressurized system. At least annually, disks should be visually inspected to the extent possible for signs of leakage, damage, or corrosion. In addition, the discharge line from the disk should be visually examined to ensure that it is free of obstructions that could inhibit the discharge of the rupture disk if needed.

7 Implementation

- 7.1 The inspection, testing, or replacement of pressure vessels, relief valves, and rupture disks shall be scheduled as part of the preventative maintenance program. Since performance of these actions requires the respective systems to be placed out of service and in a depressurized state, these actions should be combined with other opportunities where the system is accessible and in a safe condition for these actions to be performed.
- 7.2 Those inspection, testing, or replacement actions that are associated with Credited Engineered Controls in the PFSAD or NFSAD should be flagged to give special emphasis to ensure timely accomplishment.

8 References

SNS-QA-P01, SNS Quality Assurance Manual
DOE O 414.1C, "Quality Assurance"
ISO 9001:2000 "Quality Management Systems-Requirements"
ASME/NB-23, National Board Inspection Code
ORNL SBMS Subject Area, "Pressure Vessels and Related Components"



9 Appendixes

These appendixes are filed and updated separately:

Appendix A: List of B&PV Code Stamped Vessels—SNS 102040000-QA0052

Appendix B: List of Code Certified Pressure Relief Valves—SNS 102040000-QA0053

Appendix C: List of Code Certified Rupture / Burst Disks—SNS 102040000-QA0054